Effects of Food Type on Wing Form Determination and Development in Female *Thrips nigropilosus* UZEL (Thysanoptera: Thripidae)

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Thrips nigropilosus were reared individually from hatching to adult eclosion on leaf pieces of chrysanthemum, pumpkin, eggplant and broad bean under 2 photothermal conditions: 20°C and 15L: 9D, and 18°C and 10L: 14D. Wing form of female adults was examined to clarify the effect of food type on wing form determination. Mortality of both sexes and developmental period of females from hatching to adult eclosion, and head width and body length of female adults were also examined to assess suitability of (food) types tested for thrips. Irrespective of plants, macropterous and intermediate forms occurred in females under 20°C and 15L: 9D, and brachypterous and intermediate forms occurred in females under 18°C and 10L: 14D. Percentages of each wing form were not significantly different among females on different plants under each photothermal condition. Mortality was the highest and developmental period tended to be longer on broad bean than on the other 3 plants. Mortality tended to be lower on chrysanthemum than on pumpkin and eggplant. Food type did not affect head width and body length of female adults.

Key words: food type, wing form, mortality, developmental period, *Thrips nigropilosus*

INTRODUCTION

The chrysanthemum thrips, *Thrips nigropilosus* UZEL, is polyphagous and has been known as a pest of various cultivated plants (MORISON, 1957; PALMER et al., 1989). NAKAO (1993) showed that 2 distinct wing forms (macropterous and brachypterous) generally occur in females of this thrips and the production of a particular form is due to photoperiod and temperature; long-day photoperiods induce the development of the macropterous form, short-day photoperiods do so for the brachypterous form, and high temperatures partly suppress the effect of short-day photoperiods. I also revealed that females with asymmetric wing pairs appear. They were designated as intermediate form, because most of them were produced under short-day and high temperature condition, and their wing length exhibited larger continuous variability (NAKAO, 1993). In a wing-dimorphic thrips *Anaphothrips obscurus* (MÜLLER), KÖPPÄ (1970) suggested that the wing form determination is dependent on food type as well as on photoperiods, whereas no information is available about the effect of food type on wing form determination in *T. nigropilosus* and other thrips.

It is easy to suppose that the food type influences wing form determination of wing polymorphic insects, because dispersal by flight is closely associated with a shift in resource utilization. In fact, the proportion of wing forms in some wing-polymorphic

insects is due to quality of diets (HARRISON, 1980). It is often assumed that the proportion of macropterous and alate forms produced will be greater when the nutritional quality of the food is low, but this is not always the case (DADD, 1968; MITTLER and KLEINJAN, 1970). Clarifying what conditions and sorts of foods factually lead to greater proportion of a particular wing form is essential for discussion of the ecological significance of the wing polymorphism. In this study, I reared *T. nigropilosus* on 4 species of plants to clarify their influence on wing form determination. I also investigated mortality and developmental period from hatching to adult eclosion, and adult body size of the thrips to assess plant suitability for food.

MATERIALS AND METHODS

Insects. Thrips used for the present study were obtained from 2 laboratory stocks, which were established from 7 and 15 female adults of *T. nigropilosus* from leaves of *Artemisia princeps* PAMP. at Mukaijima in Kyoto, Japan, in March of 1991 and 1992, respectively. These stocks were maintained at 18°C and 15L: 9D by the method of NAKAO (1993). Pieces of *Chrysanthemum morifolium* RAMAT. (cv.: Kokkasoun) leaves were provided as food for the thrips.

Food types. Fresh leaves of chrysanthemum (*C. morifolium*) (race: Kokkasoun), pumpkin (*Cucurbita maxima* DUCH.) (cv.: Ebisu), eggplant (*Solanum melongena* L.) (cv.: Senryo-ni-go) and broad bean (*Vicia faba* L., provided by International Fodder Industry Co., Ltd. as food for pigeons) were provided as food. Chrysanthemum is the most common host of *T. nigropilosus* (MOUND et al., 1976; PALMER et al., 1989). Cucurbits and eggplant have been also recorded as hosts (PALMER et al., 1989). In Leguminosae, *Trifolium pratense* (MIYAZAKI and KUDO, 1988) and mung bean (PALMER et al., 1989) have been known as hosts, but not broad bean.

Experimental procedure. Forty female pupae were transferred from the stocks, and reared on the 4 plants under 2 photothermal conditions. Four, 5, 3 and 8 female pupae were separately put into cages (18 mm dia. × 49 mm ht.); each cage contained a piece of leaf of chrysanthemum, pumpkin, eggplant or broad bean, respectively. Rearing was at 20°C and 15L: 9D. Similarly 4, 4, 4 and 8 females were separately reared on the 4 plants, at 18°C and 10L: 14D. Two days after adult eclosion, all 40 of the females were allowed to mate once with newly emerged males. The once-mated females were transferred into fresh cages with fresh leaf pieces every 1–2 days, and leaf pieces in which thrips eggs were laid were kept in the cage under the same photothermal conditions. Within a day after hatching, the offspring were transferred individually into fresh cages with leaf pieces of the same kinds of plants, and reared to adult eclosion under the same photothermal conditions as their parents had been. As a general rule, development and health condition were checked daily. After adult eclosion, female offspring were mounted in Neo-shigaral® on glass slides by the method of NAKAO (1993) to measure their body length, head width and forewing length. Wing form of the females was determined as described in a previous paper (NAKAO, 1993).

RESULTS AND DISCUSSION

Mortality and development

Mortality from hatching to adult eclosion of *T. nigropilosus* was significantly higher

Fig. 1. Mortality from hatching to adult eclosion of *T. nigropilosus* reared on leaf pieces of 4 cultivated plants under 2 photothermal conditions. Numbers in parentheses indicate sample size. Values with different letters in the same columns were significantly different by FISHER's exact probability test (a-b: at the 0.1% level, a-c: at the 1% level, b-c: at the 5% level).

Fig. 2. Mean developmental period from hatching to adult eclosion of *T. nigropilosus* females reared on leaf pieces of 4 cultivated plants under 2 photothermal conditions. Horizontal bars indicate standard deviation. Numbers in parentheses indicate sample size. Means with different letters in the same columns were significantly different at the 0.1% level from each other by MANN-WHITNEY *U*-test.

in the population on broad bean than in those on the other 3 plants under the 2 photothermal conditions (Fig. 1). At 20°C and 15L: 9D the mortality among the populations on the latter 3 plants did not differ significantly. On the other hand, at 18°C and 10L: 14D the mortality was significantly higher in the populations on pumpkin and on eggplant than in that on chrysanthemum, and no significant difference was found between the former 2 populations (Fig. 1).

At 20°C and 15L: 9D mean developmental period from hatching to adult eclosion of the female thrips was significantly longer in the population on broad bean than in each population on the other 3 plants (Fig. 2), and no significant difference was found between the latter 3 populations (Fig. 2; MANN-WHITNEY *U*-test, $p > 0.05$). At 18°C and 10L: 14D, mean developmental period was significantly longer in the populations

Table 1. Biometric data of *T. nigropilosus* females reared on leaf pieces of 4 cultivated plants (intermediate forms were excluded)

Temperature and photoperiod	Plant	<i>N</i>	Head width in mm ^a (mean ± S.E.)	Body length in mm ^a (mean ± S.E.)	RWL-ratio of forewing length to head width ^b (mean ± S.E.)
20°C, 15L: 9D	Chrysanthemum	36	0.143 ± 0.001	1.078 ± 0.014	4.812 ± 0.058 a
	Pumpkin	40	0.144 ± 0.001	1.068 ± 0.016	4.758 ± 0.059 a
	Eggplant	16	0.143 ± 0.001	1.110 ± 0.015	4.458 ± 0.061 b
	Broad bean	23	0.140 ± 0.001	1.031 ± 0.020	4.417 ± 0.066 b
18°C, 10L: 14D	Chrysanthemum	34	0.150 ± 0.001	1.076 ± 0.014	1.020 ± 0.017 ab
	Pumpkin	27	0.152 ± 0.002	1.110 ± 0.020	1.061 ± 0.020 a
	Eggplant	21	0.150 ± 0.001	1.100 ± 0.025	0.968 ± 0.019 b
	Broad bean	11	0.150 ± 0.002	1.100 ± 0.023	0.991 ± 0.024 ab

^a Means in the same columns in each tier were not significantly different at the 5% level by KRASKAL-WALLIS analysis of variance of rank.

^b Means with different letters in the same columns in each tier were significantly different at the 5% level from each other by MANN-WHITNEY *U*-test.

Fig. 3. Effect of food types on wing form determination of *T. nigropilosus* females. Numbers in parentheses indicate sample size. Proportions of wing forms in the same columns were not significantly different at the 5% level from each other by FISHER's exact probability test.

on broad bean and on eggplant than in those on chrysanthemum and on pumpkin (Fig. 2). No significant difference was found between the latter 2 populations (Fig. 2; MANN-WHITNEY *U*-test, $p > 0.05$).

These results suggest that broad bean is less favorable as a food for this thrips than the other 3 plants, and that among them chrysanthemum is the most favorable.

At each photothermal condition, both mean head width and mean body length of the female thrips were not significantly different among the populations on each plant (Table 1).

Wing form and wing length

At 20°C and 15L:9D macropterous and intermediate forms occurred in the females reared on each plant, while at 18°C and 10L:14D brachypterous and intermediate forms developed (Fig. 3). In both photothermal conditions, the proportion of wing forms of groups of females reared on the 4 plants did not significantly differ (Fig. 3). As mentioned above, chrysanthemum and broad bean were widely different in their suitability as foods for *T. nigropilosus*. This indicates that food type does not appreciably affect wing form determination of *T. nigropilosus* females. This is in contrast to KÖPPÄ's finding in *A. obscurus* females (1970) that most thrips fed on oats developed into macropters and ones reared on timothy developed into brachypters. It is unfortunate that he did not mention which grass is more favorable for this thrips.

Mean RWL (ratio of forewing length to head width) of macropterous females was significantly higher in the chrysanthemum and pumpkin populations than in those reared on eggplant and broad bean (Table 1). This tendency was also observed in brachypterous females, although significant differences were not always found between the populations on the 4 plants (Table 1). In addition, it was remarkable to note that a single intermediate female on pumpkin and 2 intermediate females on broad bean at 20°C and 15L:9D had RWLs below 2.0, whereas the other intermediate females at the same photothermal condition had RWLs above 4.0. On the other

hand, at 18°C and 10L:14D all the intermediate females had RWLs below 1.3, irrespective of food type. These results intimate that female *T. nigropilosus* reared on less favorable food types tended to have shorter wings than those reared on more favorable foods, especially under the photothermal conditions which generally lead to macroptery. This reason(s) should be clarified in further study.

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